Align Debuncher and Accumulator Bend Fields

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Last Modified: 10-12-05 by Brian Drendel
Created: 9-28-05 by Brian Drendel
Send comments and suggestions to the **Pbar Tuning Guide Admins**

Draft Release 0.25

Introduction:

This document is divided into multiple sections. Click on the section title to go directly to the corresponding section.

1. Introduction: The introduction outlines all of the sections contained in this document and provides quick links that allow the reader to go directly to any section.
2. Revision History: The revision history lists the dates and changes made in each major revision of this document.
3. Prerequisites: This is a list of what items need to be tuned before you can complete this procedure.
4. Background: The background section gives an overview of why we align the Accumulator and Debuncher bend fields.
5. Setup: This section outlines what setup is required prior to starting this procedure.
6. Full Length Procedure: This is the full length version of the procedure, complete with screen captures and detailed discussion.
7. Condensed Procedure: This is a condensed version of the procedure without any screen captures, nor discussion.
8. Printable Version: The HTML version of this document is optimized for viewing. Go to the printable version for a PDF file optimized for printing.

Revision History:

Before completing this tuning procedure, make sure that you have already verified that the following tuning has been completed:

1. Draft Release v0.10 (9-28-05 by Brian Drendel): Completed the condensed procedure.
2. Draft Release v0.15 (10-11-05 by Brian Drendel): Added screen captures for full-length procedure. Added labels to plots in the background section.
3. Draft Release v0.16 (10-11-05 by Brian Drendel): Wrote background section.
4. Draft Release v0.20 (10-11-05 by Brian Drendel): Wrote Full Length Procedure Parts 1 and 2.
5. Draft Release v0.21 (10-12-05 by Brian Drendel): Wrote Full Length Procedure Part 3.
6. Draft Release v0.22 (10-12-05 by Brian Drendel): Wrote Full Length Procedure Part 4. Added the Stacking Monitor to the background section.
7. Draft Release v0.23 (10-12-05 by Brian Drendel): Opened to Pbar On-call personnel for review
8. Draft Release v0.25 (10-12-05 by Brian Drendel):

Prerequisites:

Before completing this tuning procedure, make sure that you have already verified that the following tuning has been completed:

1. Target Tune
2. Debuncher Closure
3. Bunch Rotation
4. Debuncher Momentum Cooling and DRF2 Alignment

Background

The purpose of this document is to outline how to align the Debuncher and Accumulator bend fields while stacking. We start the procedure by setting the magnetic field in the Accumulator dipole magnets. If we increase the setting on the Accumulator bend bus (A:IB), the magnetic field in the dipole magnets will increase. Likewise, if we decrease the setting on the Accumulator bend bus, the magnetic field in the dipole magnets will decrease. We have an NMR probe that accurately measures the magnetic field in the a reference magnet attached to the A:IB bus. It has been determined that Accumulator NMR probe reading (A:NMR50) of 16,720 ± 0.2 Gauss provides the desired magnetic bend field while we are stacking. To set the magnetic bend field in the Accumulator, we simply adjust the value of A:IB until we get the desired value for A:NMR50.

However, before we make this adjustment there are a few things that we need to take into account. These include the effects of turning on from access, and ramping between the stacking and shot lattices. If we are turning on from access, the magnets take a finite amount of time to get to their thermal equilibrium temperature. As the magnets warm up the physical aperture expands, which results in a decreased magnetic field reading at the location of the gauss probe. Thus, we see that A:NMR50 decreases slowly after an access as the magnets are warming up. However, the magnetic field is not changing as much as it appears from looking at A:NMR50. As the magnets warm up, they also become longer which results in a greater integrated magnetic field in the dipoles. The NMR probe cannot see the effects of the magnet length. The magic question is: how do we know exactly what the integrated magnetic field is when we first turn on?

The answer is that we don't. The good news is at first order, the effects of decreased magnetic field due to increasing aperture and increased magnetic field due to increasing magnet length cancel each other out. So, even though the reading from A:NMR50 is decreasing when we first turn on from an access, the magnetic field is likely remaining fairly constant. We also know what value we need to run A:NMR50 at once the magnets have reach thermal equilibrium. As a result, it is good practice not to adjust the magnetic field after we have reached thermal equilibrium. Figure 1 shows the behavior of A:NMR50 for six hours following a long Pbar Rings access.

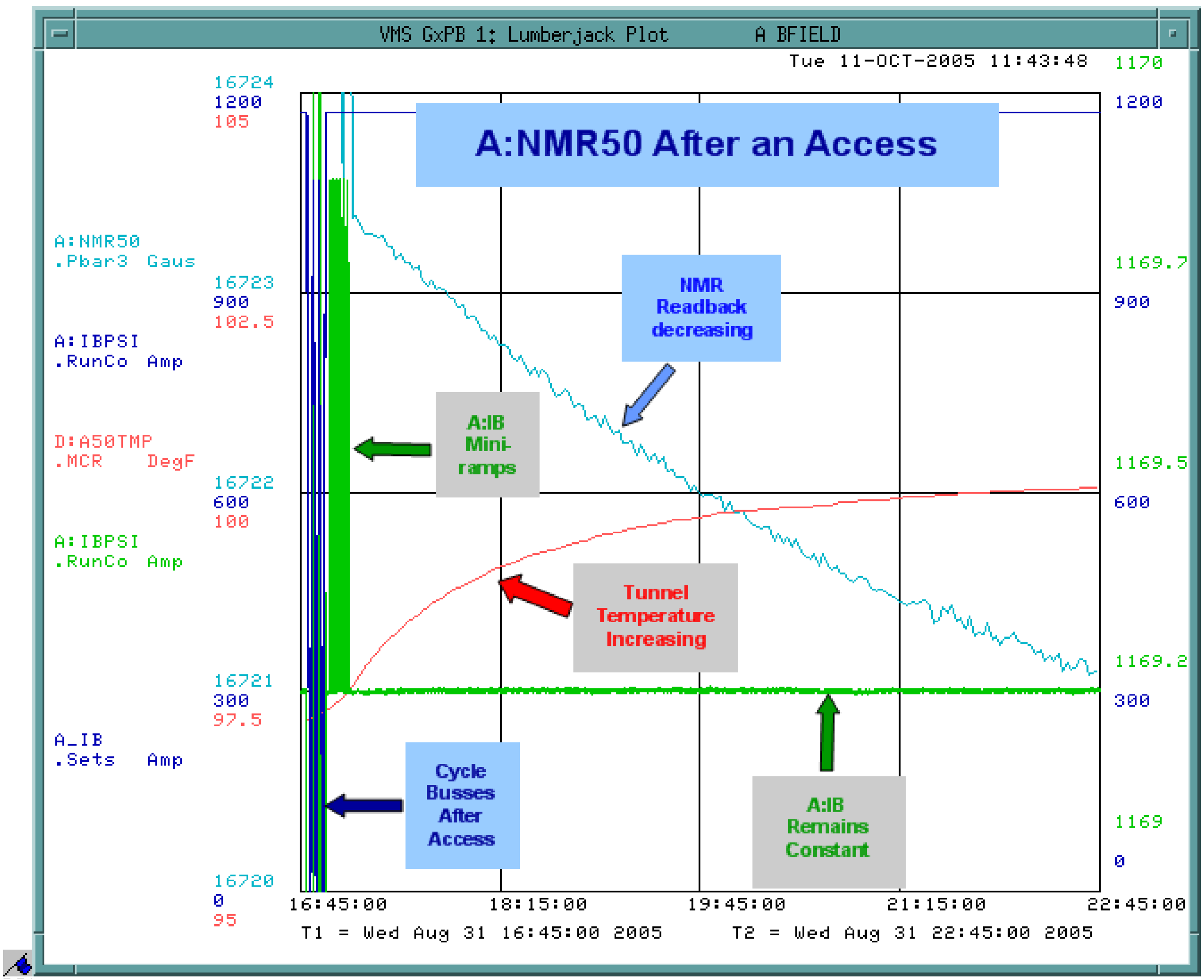


Figure 1: After an access it is normal to see the Accumulator gauss probe value decrease for a number of hours as the magnet temperatures increase. The Accumulator bend field should not be adjusted (especially downward) until an equilibrium is established.

Shot setup can also impact the reading of A:NMR50. On a Tevatron shot that includes transfers from the Accumulator, the Accumulator bus supplies are ramped to the shot lattice. The bend field is run such that A:NMR50 is ~11 Gauss higher on the shot lattice than it is on the stacking lattice. As a result, we should not adjust the Accumulator bend field to the stacking lattice value when on the shot lattice. After ramping back to the stacking lattice, sometimes a small Accumulator bend bus change is needed. Figure 2 shows how ramping A:IB to/from the shot lattice affects A:NMR50. It is important to remember that this does not apply to transfers to the Recycler or Recycler-only shots to the Tevatron, since the Accumulator remains in the stacking lattice in both cases. If you are in doubt as to which lattice we are on, just check the state parameter V:APSLAT. A value of 1 means we are on the stacking lattice, and a value of 2 means that we are on the shot lattice.

Debuncher Bend Bus

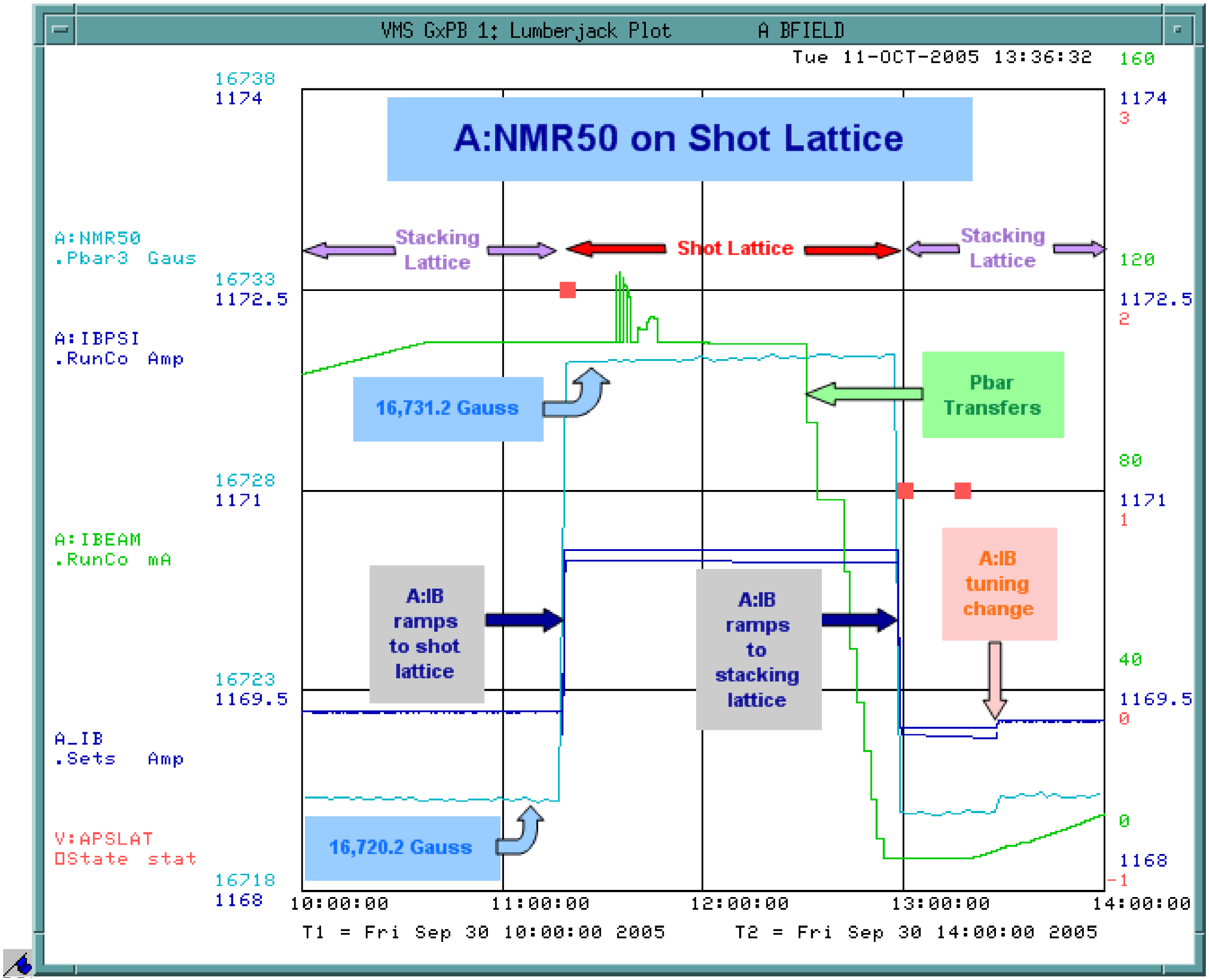


Figure 2: When we ramp to the shot lattice we change the value of A:IB that results in an ~11 Gauss change in the magnetic field. We should not adjust the magnetic field back to the stacking lattice value while on the shot lattice. Sometimes an A:IB adjustment is required after ramping back to the stacking lattice.

Once we have set the bend field to make the Accumulator NMR probe (A:NMR50) read 16,720 ± 0.2 Gauss, we next have to adjust the Debuncher Bend field to match. Currently, the Debuncher gauss probe is not as trustworthy as the one used for the Accumulator. There is a new Debuncher NMR probe, but there are some controls issues that need to be resolved in order to use it. As a result, we do not currently use the Debucher NMR probe to set the field.

How do we set the Debuncher magnetic field without using the Debuncher gauss probe? First we verify that the Debuncher Momentum Cooling is aligned properly to 590018Hz as seen in the Align DRF2 to Debuncher Momentum Cooling procedure. Once this is done, we use the FFT Box VSA to check the relative alignment between the Accumulator and Debuncher bend fields.

The FFT display is located on CATV Pbar channel 17, which updates every beam pulse. The FFT display is also mirrored every five seconds online at http://www-bd.fnal.gov/sda/engines/files/plots/dToaFFTSpectrum.png. The top trace of the FFT display represents the injection frequency of the Accumulator and the bottom trace represents the revolution frequency of the Debuncher. To align the Debuncher and Accumulator bend fields, we adjust the Debuncher Bend field (D:IB) to align the two traces. Figure 4 shows the FFT box VSA with the two traces aligned.

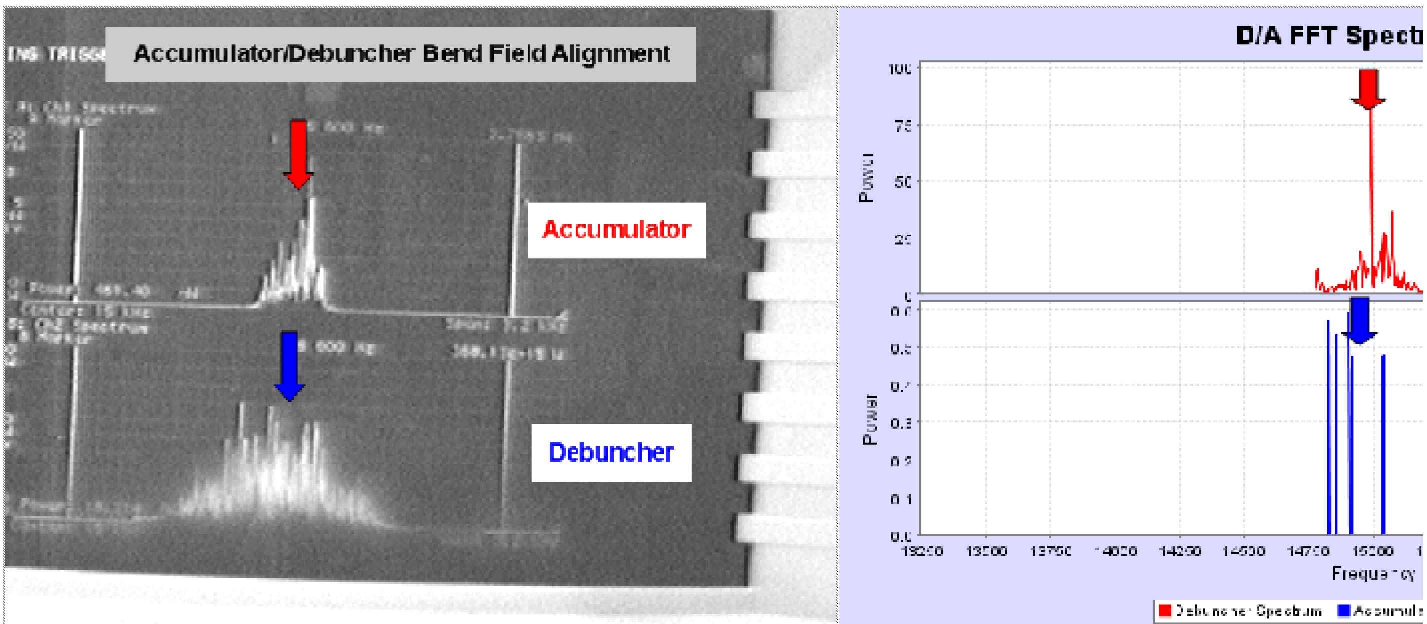


Figure 3: Both plots are the FFT VSA. The plot on the left shows CATV Pbar channel #17. The plot on the right is the web mirror of the FFT display located at http://www-bd.fnal.gov/sda/engines/files/plots/dToaFFTSpectrum.png. The traces on both plots are the same. The top trace is the Accumulator injection frequency and the bottom trace is the Debuncher revolution frequency. If the magnetic bend fields are aligned between the two machines, then the peaks of the two traces should line up horizontally.

If changes are made to the Accumulator and Debuncher bend fields, then the optimal pickup frequency for ARF1 will change. As a result, we will need to tune-up ARF1 after adjusting the bend fields. To determine the optimal ARF1 pickup frequency, we use the Stacking Monitor VSA as shown in Figure 4. When the Stacking Monitor VSA (SA1136) is running with A:VSARST = 12 or 13, then a number of Accumulator profile parameters are measured. The green trace represents the Accumulator profile triggered before ARF1 ramps. The cyan trace represents the Accumulator profile after ARF1 has swept the injected beam to the deposition orbit. The red trace is the ratio of the green trace to the cyan trace in dB.

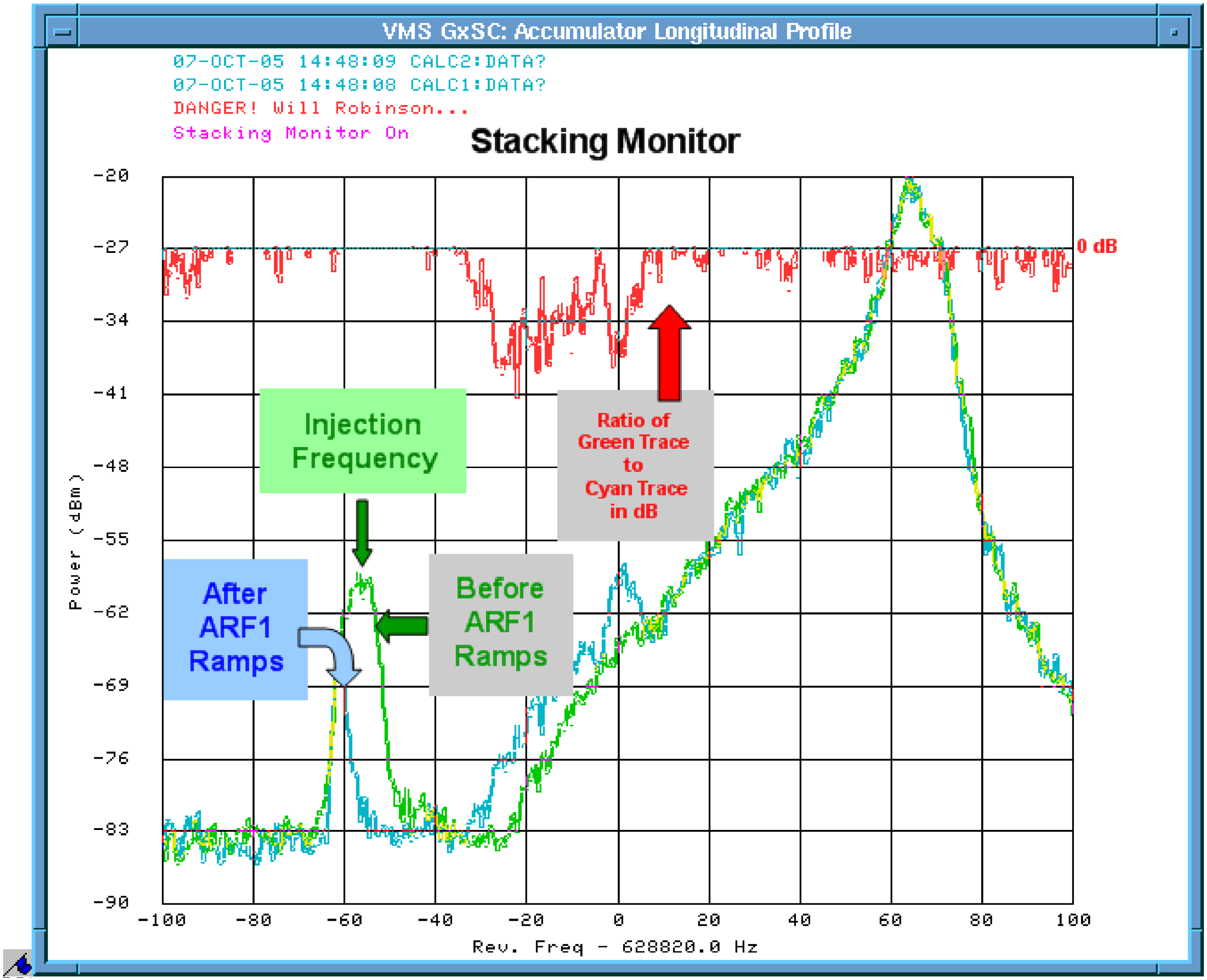


Figure 4: Stacking Monitor display. The green trace represents the Accumulator profile triggered before ARF1 ramps. The cyan trace represents the Accumulator profile after ARF1 has swept the injected beam to the deposition orbit. The red trace is the ratio of the green trace to the cyan trace in dB.

A number of important parameters are generated by the Stacking Monitor. A:IBMINJ is the amount of beam in units of 1 x 10^7 injected on the injection orbit. It is the integral of the green trace in the injection orbit area. Since we are trying to get more beam to the Accumulator, we would like to see this number increase assuming beam delivered to the Debuncher remains constant. A:LFTOVR is the ratio of beam left after ARF1 ramps (cyan trace integrated over the injection orbit area) to A:IBMINJ. The smaller this number is, the more beam we are delivering to the stacktail for a given A:IBMINJ. As a result, we would like to see this number as small as possible, without overloading the stacktail, after our tuning efforts. A:R1FINJ is not generated by the Stacking Monitor, but is the ARF1 pickup frequency generated by the P153 ARF1 curves. The VSA compares A:R1FINJ with the average revolution frequency of the injected beam (labeled injection frequency on Figure 4). A:R1FIJD is the difference between the two frequencies. Ideally the difference should be zero, so we tune the ARF1 curves to minimize this value. For more information on the Stacking Monitor and all of the other tuning parameters that it generates, see Dave McGinnis' Documents Database Document #1942.

Setup

You will need to setup the FFT VSA. This is not the same VSA used for monitoring the Stacktail. The FFT VSA display should appear as shown in Figure 4 on Pbar CATV channel 17, and should update with every stacking pulse. If the display is not updating, then the FFT box can be setup using P148 as documented is the "Full Length Procedure."

The Stacktail monitor (SA1136) should also be running with A:VSARST = 12 or 13. If it is not, it can be started from P142.

Full Length Procedure:

The full length procedure can be broken down into the following parts:

1. Part 1: Set the Accumulator Bend Field
2. Part 2: Setup the FFT VSA
3. Part 3: Set the Debuncher Bend Field
4. Part 4: Optimize ARF1 injection frequency

Full Length Procedure: Part 1 - Set Accumulator Bend Field

The following steps should be completed to set the Accumulator Bend field. Guidance on when and when not to do this are provided in the background section. This section contains screen captures and detailed discussion. If you are already familiar with this procedure and would prefer to review a condensed version of this procedure, then click here.

1. Start a FTP from Utility Window FTP Pbar File 101.

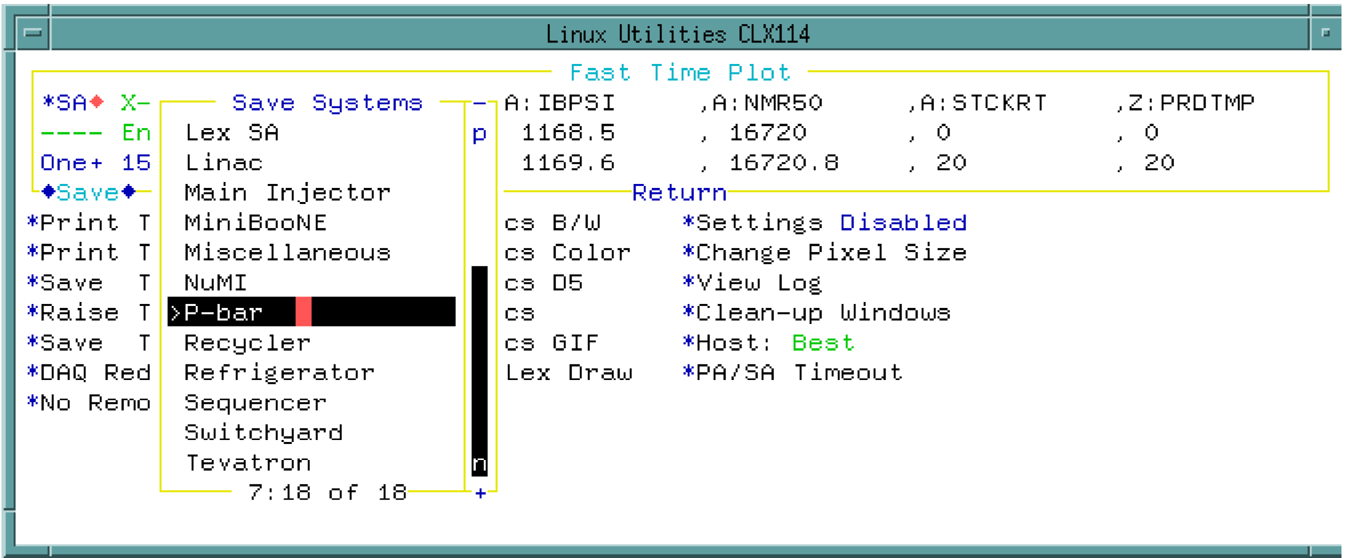


Figure 5: From the Utilities Window, click on FTP, then click on Restore, and then select P-bar.

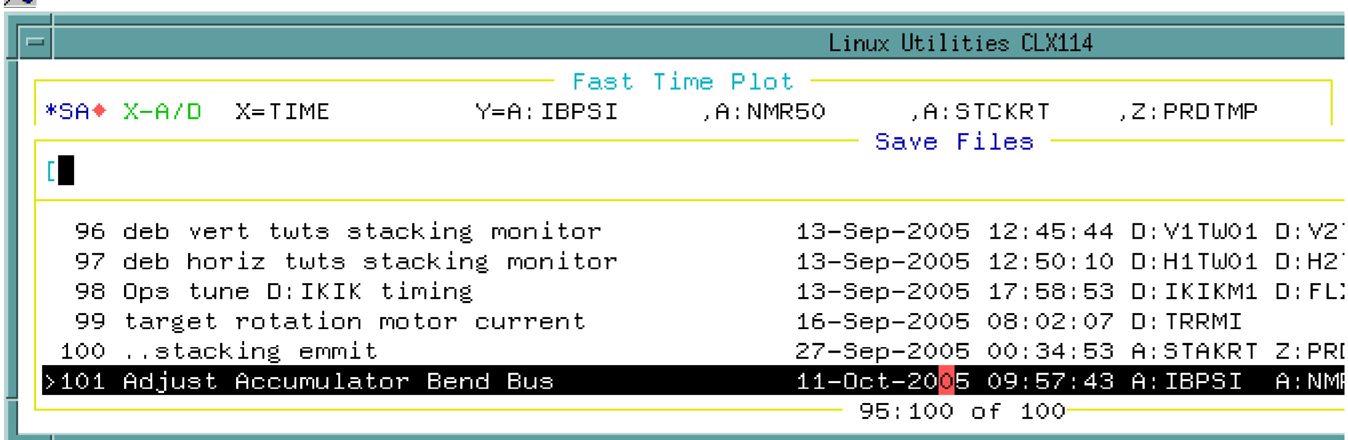


Figure 6: Select file 101 and then start the FTP.

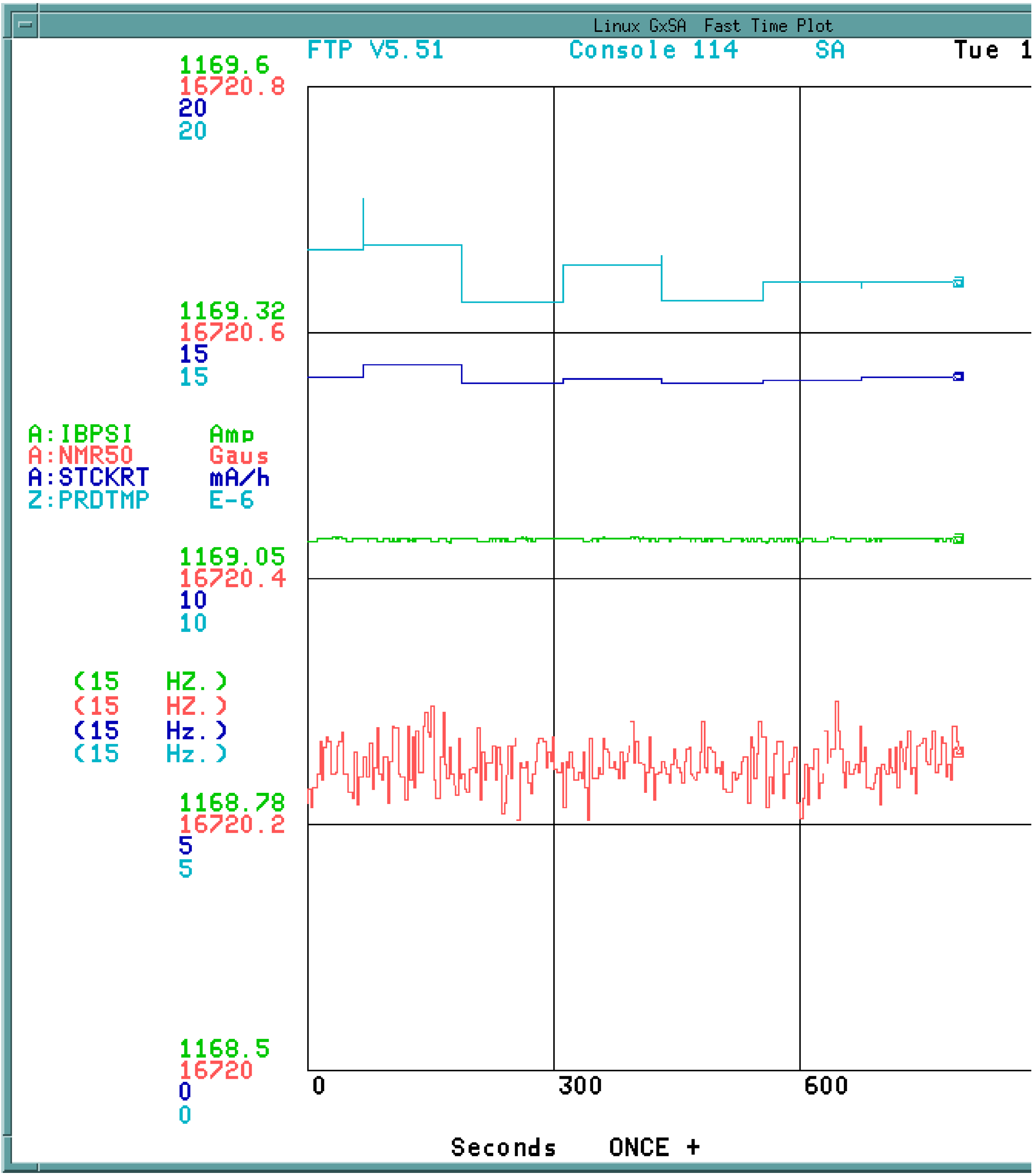


Figure 7: FTP showing the high precision Accumulator bend field reading A:IBPSI and the accumulator magnetic field reading. Stackrate and Production are also on this plot.

2. Open Page P60 ACC50 <40>.

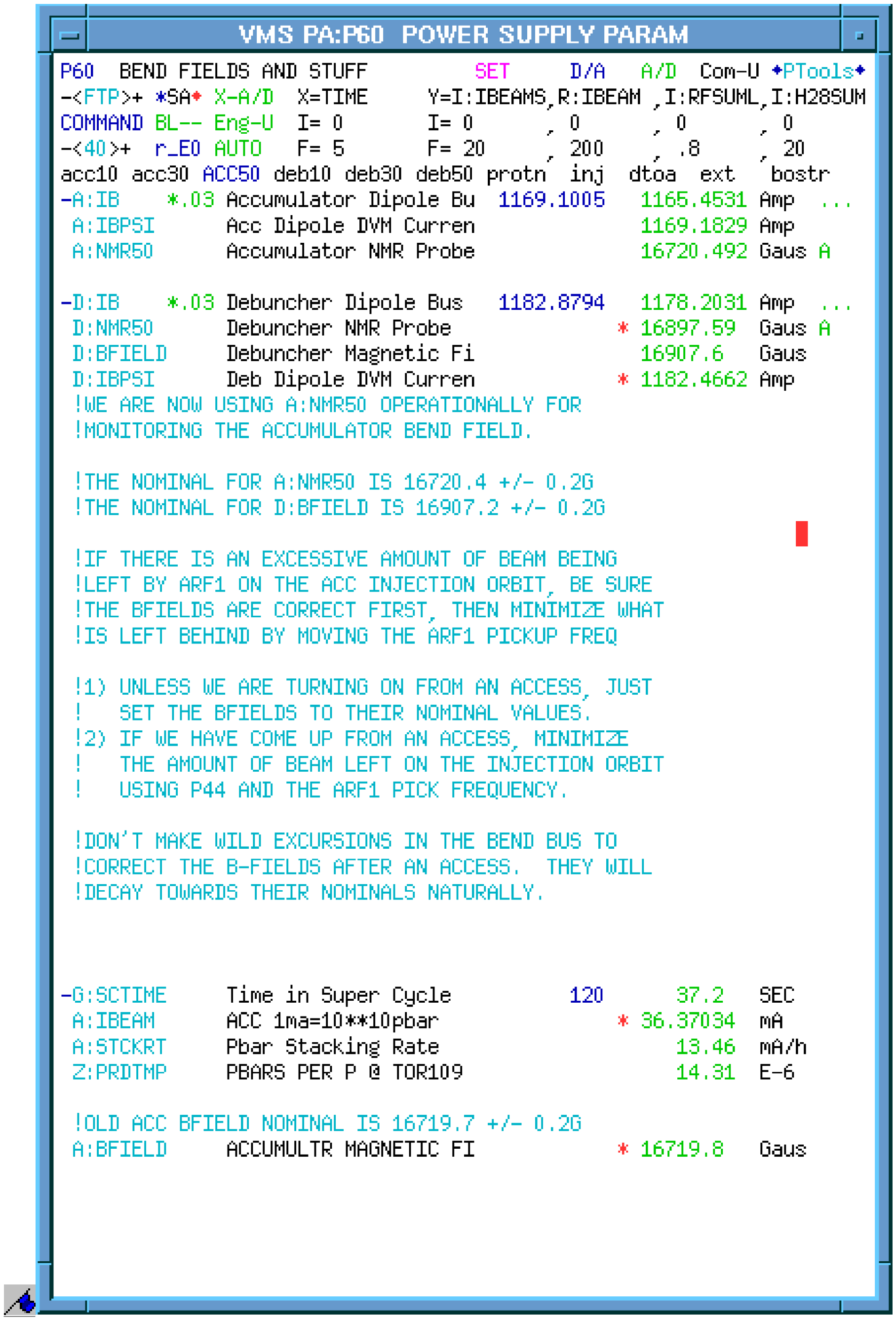


Figure 8: The Accumulator bend field can be adjusted from P50 ACC50 <40>.

3. Knob A:IB in small increments using the knob "+" (F4) and knob "-" (F5) keys on the console until A:NMR50 is brought back in tolerance. Make slow changes and watch the FTP started above.
4. If the bend field change does not negatively impact stacking, move on to Part 2.
5. If the bend field makes a negative impact on stacking, back out of the change and contact a Pbar on-call expert.

Full Length Procedure: Part 2 - Setup FFT VSA

To align the Debuncher bend field to the Accumulator bend field, we are going to use the FFT VSA. If the FFT VSA is not setup or functioning correctly, we will have to set it up as shown here. If the FFT VSA is updating and setup properly, then skip ahead to Part 3 of this procedure.

1. Check the FFT display on Pbar CATV channel #17. If the scope trace has both upper and lower signals as see in Figure 4, and is updating on every stacking pulse, then skip ahead to Part 3. If the FFT display does not have two traces or is not updating, then setup the FFT box as follows.
2. Turn off the FFT OAC parameter by setting D:DAUSER to 0.
3. Open P148
4. Click on "Setup VSA" and scroll to the file titled "PFD Testing" as shown in Figure 9.

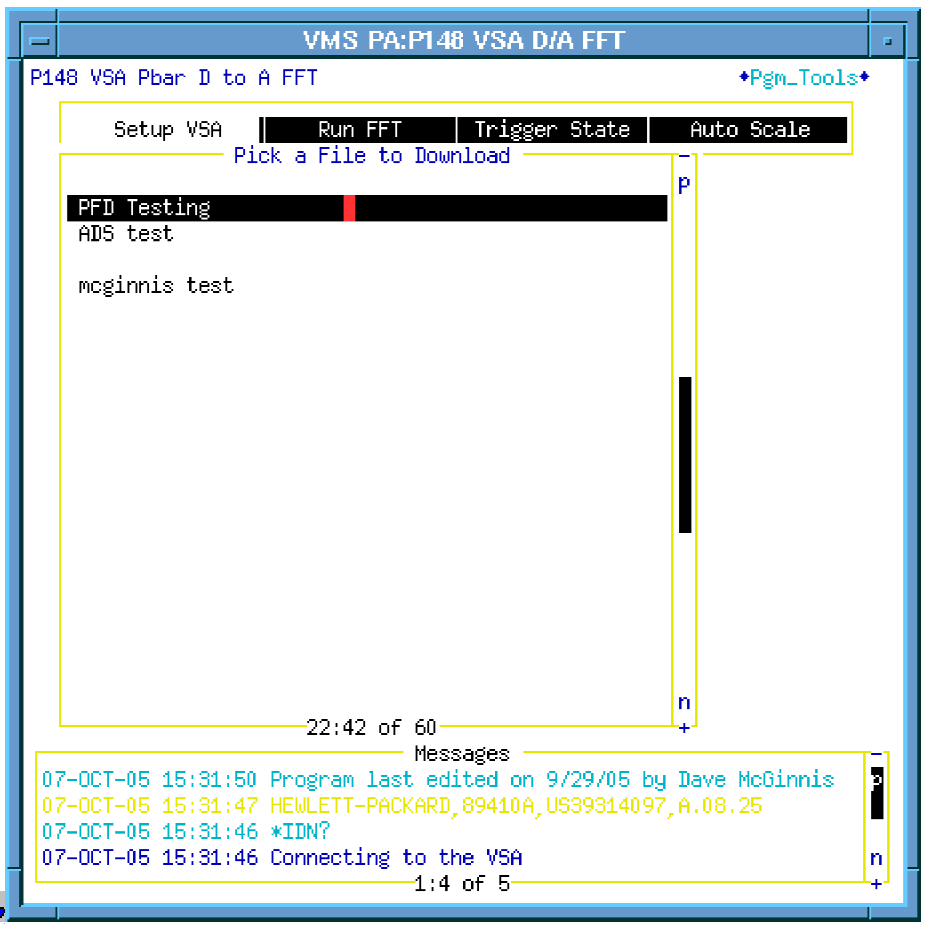


Figure 9: From P148 we load the file "PFD Testing."

5. After clicking on the file "PFD Testing," the FFT box setup will appear as shown in Figure 10. Click on the open space

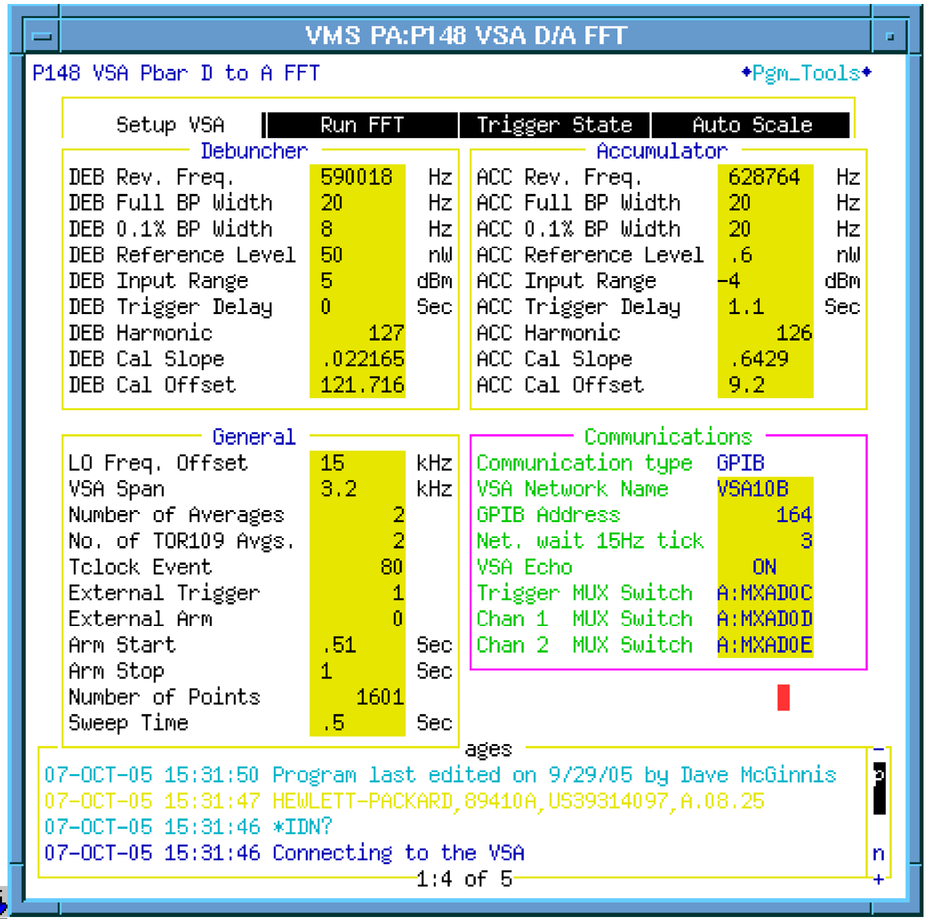


Figure 10: The configuration loaded from the "PFD Testing" file. To load this configuration to the FFT Box, simply click in the lower right below the "Communications" box and above the "Messages Window." The location of the cursor shown in the above page is a good place to click.

6. After P148 completes its configuration download to the FFT Box, verify that the FFT Box display is updating on CATV Pbar channel 17 as shown in Figure 4.
7. Turn on the FFT OAC parameter by setting D:DAUSER to 1.

Full Length Procedure: Part 3 - Align Debuncher Bend Field with Accumulator Bend Field

In Part 1 and Part 2 of this procedure we optimized the Accumulator bend field and then setup the FFT box. This portion of the procedure will have us use the FFT Box display as a guide to align the Debuncher bend field with the Accumulator bend field.

1. Start a FTP from Utility Window FTP Pbar File 88. This FTP will show changes to the Debuncher bend bus and their effect on the Debuncher gauss probe, beam on the injection orbit, and stacktail power. The goal is to get more beam injected into

the Accumulator and have more beam make it to the stacktail. If stacktail power increases, there is more beam to the stacktail.

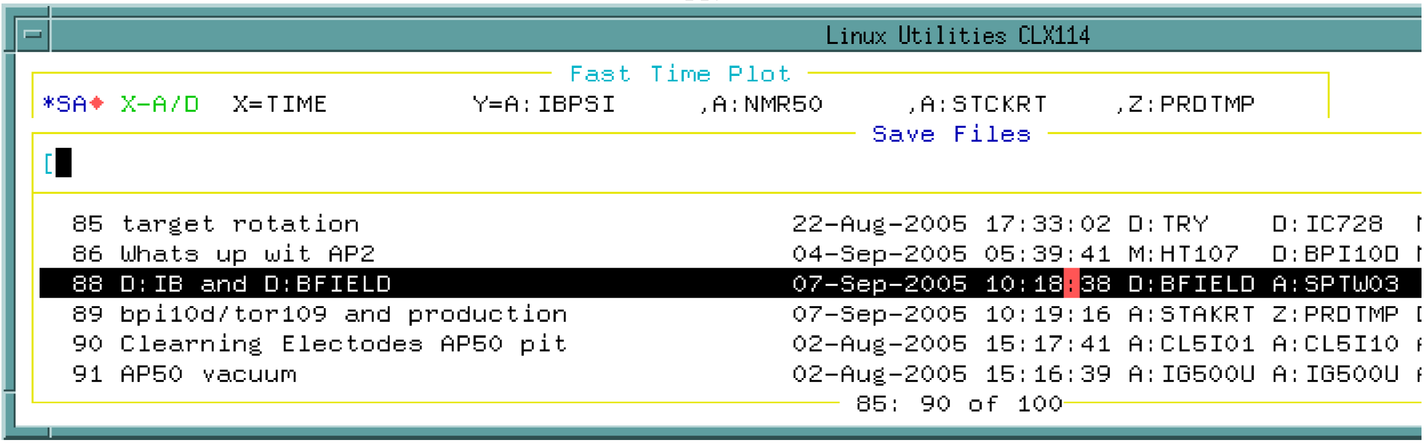


Figure 11: From the Utilities Window, click on FTP, then click on Restore, and then select P-bar. Select file 88 and start the FTP.

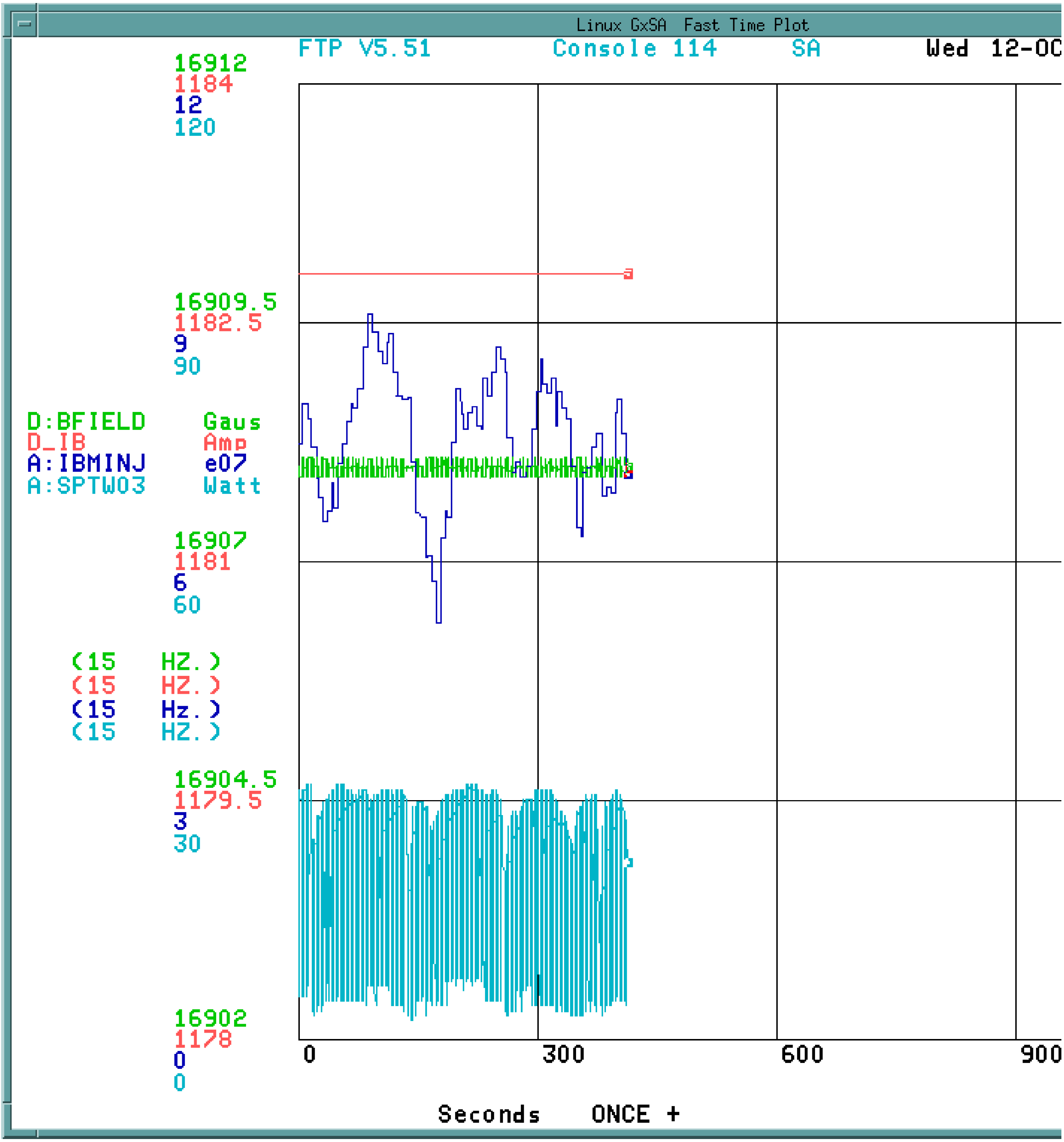


Figure 12: FTP Pbar #88 started as shown in Figure 11. This FTP will show changes to the Debuncher bend bus and their effect on the Debuncher gauss probe, beam on the injection orbit, and stacktail power.

2. Start a FTP from Utility Window FTP Pbar File 89. Do not overwrite the plot that

was started above in Figure 11. This FTP shows normalized circulating Debuncher beam, stack rate and production. The goal is to not decrease normalized circulating Debuncher beam, and to increase stack rate and production.

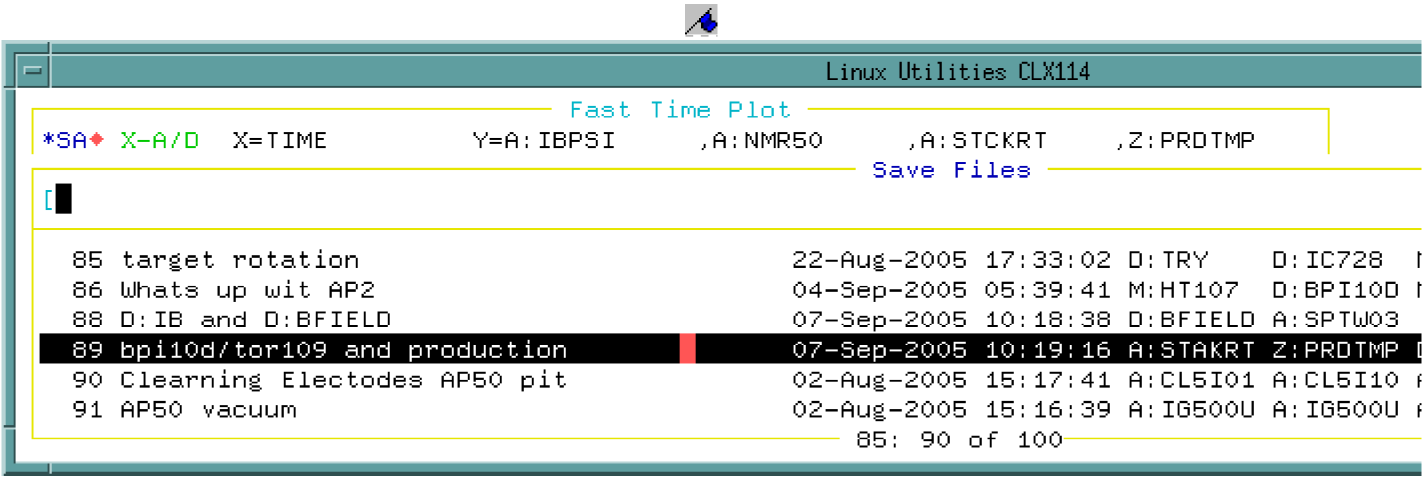


Figure 13: From the Utilities Window, click on FTP, then click on Restore, and then select P-bar. Select file 89 and start the FTP.

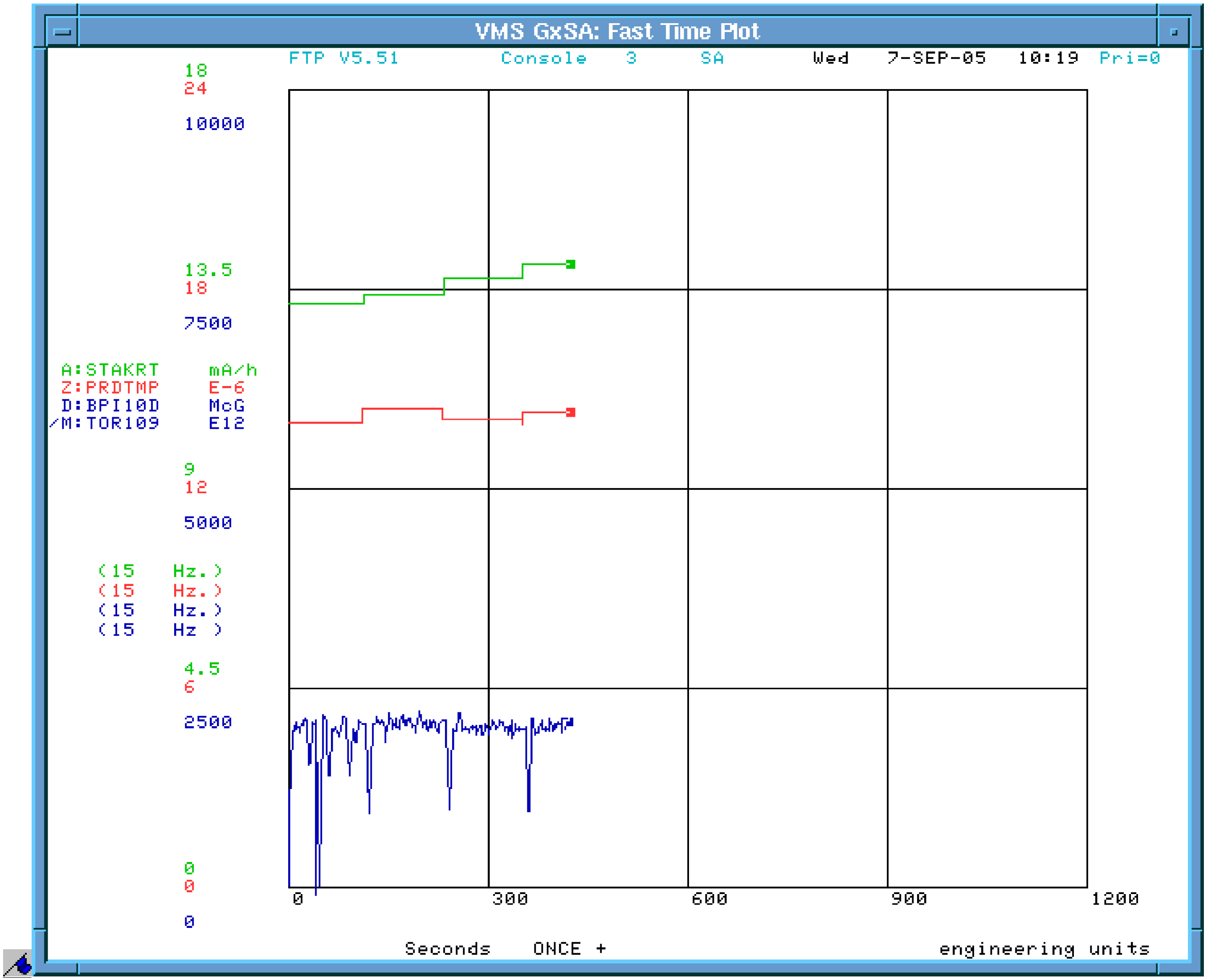
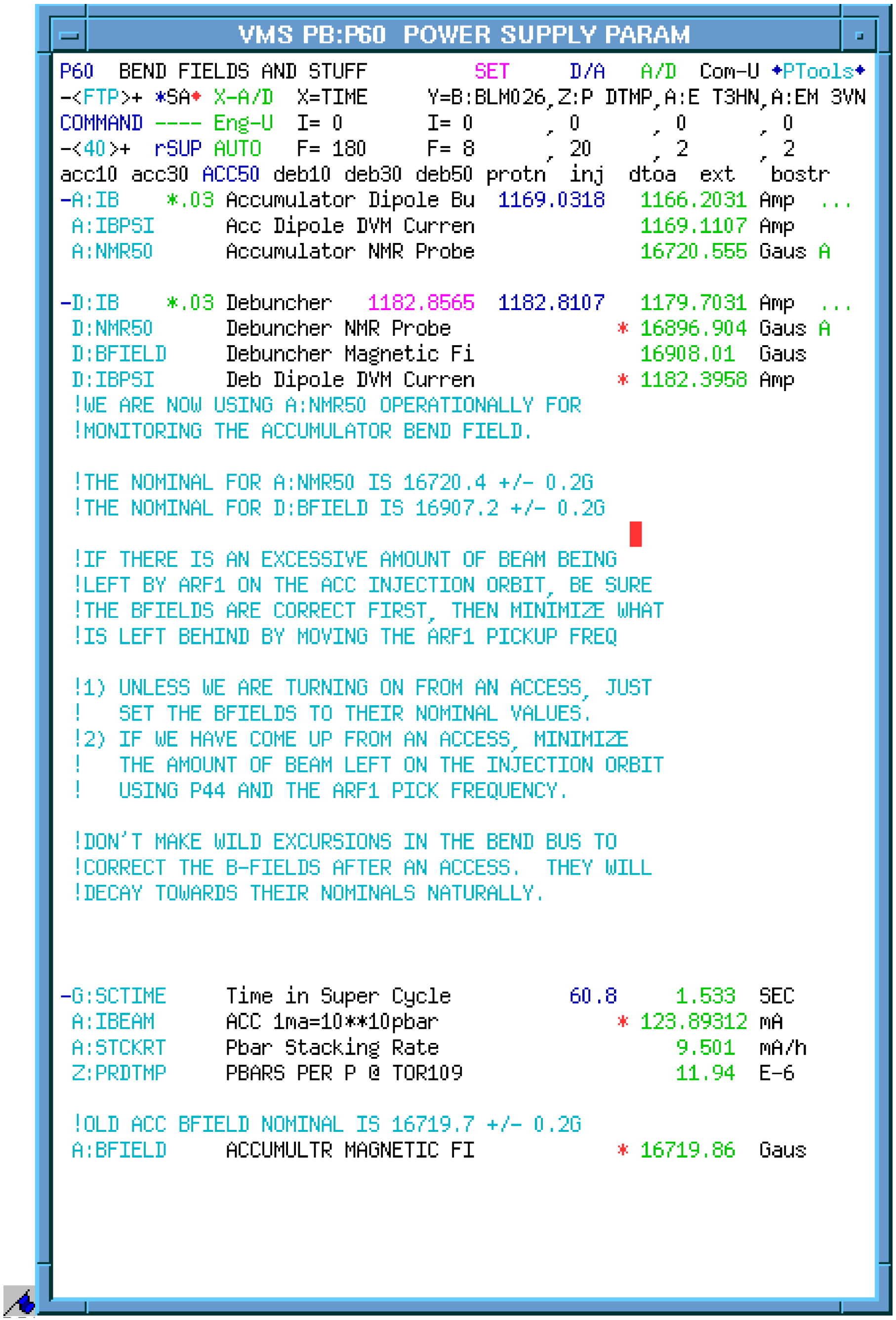


Figure 14: FTP Pbar #89 started as shown in Figure 13. This FTP shows normalized circulating Debuncher beam, stack rate and production. The goal is to not decrease normalized circulating Debuncher beam, and to increase stack rate and production.

3. Open page P60 ACC50 <40> as shown in Figure 15.



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VMS PB:P60  POWER SUPPLY PARAM
P60   BEND FIELDS AND STUFF            SET      D/A    A/D   Com-U ♦PTools♦
-<FTP>+ *SA♦ X-A/D  X=TIME      Y=B:BLM026,Z:P DTMP,A:E T3HN,A:EM 3VN
COMMAND ---- Eng-U  I= 0        I= 0       , 0       , 0       , 0
-<40>+  rSUP AUTO   F= 180      F= 8       , 20      , 2       , 2
acc10 acc30 ACC50 deb10 deb30 deb50 protn  inj  dtoa  ext   bostr
-A:IB     *.03 Accumulator Dipole Bu  1169.0318   1166.2031 Amp  ...
 A:IBPSI       Acc Dipole DVM Curren              1169.1107 Amp
 A:NMR50       Accumulator NMR Probe              16720.555 Gaus A

-D:IB     *.03 Debuncher    1182.8565  1182.8107   1179.7031 Amp  ...
 D:NMR50       Debuncher NMR Probe               * 16896.904 Gaus A
 D:BFIELD      Debuncher Magnetic Fi               16908.01  Gaus
 D:IBPSI       Deb Dipole DVM Curren             * 1182.3958 Amp
 !WE ARE NOW USING A:NMR50 OPERATIONALLY FOR
 !MONITORING THE ACCUMULATOR BEND FIELD.

 !THE NOMINAL FOR A:NMR50 IS 16720.4 +/- 0.2G
 !THE NOMINAL FOR D:BFIELD IS 16907.2 +/- 0.2G

 !IF THERE IS AN EXCESSIVE AMOUNT OF BEAM BEING
 !LEFT BY ARF1 ON THE ACC INJECTION ORBIT, BE SURE
 !THE BFIELDS ARE CORRECT FIRST, THEN MINIMIZE WHAT
 !IS LEFT BEHIND BY MOVING THE ARF1 PICKUP FREQ

 !1) UNLESS WE ARE TURNING ON FROM AN ACCESS, JUST
 !   SET THE BFIELDS TO THEIR NOMINAL VALUES.
 !2) IF WE HAVE COME UP FROM AN ACCESS, MINIMIZE
 !   THE AMOUNT OF BEAM LEFT ON THE INJECTION ORBIT
 !   USING P44 AND THE ARF1 PICK FREQUENCY.

 !DON'T MAKE WILD EXCURSIONS IN THE BEND BUS TO
 !CORRECT THE B-FIELDS AFTER AN ACCESS.  THEY WILL
 !DECAY TOWARDS THEIR NOMINALS NATURALLY.


-G:SCTIME      Time in Super Cycle          60.8      1.533   SEC
 A:IBEAM       ACC 1ma=10**10pbar            * 123.89312 mA
 A:STCKRT      Pbar Stacking Rate                 9.501   mA/h
 Z:PRDTMP      PBARS PER P @ TOR109               11.94   E-6

 !OLD ACC BFIELD NOMINAL IS 16719.7 +/- 0.2G
 A:BFIELD      ACCUMULTR MAGNETIC FI         * 16719.86   Gaus
```

Figure 15: P60 ACC50 <40>. Knob the Debuncher bend bus in small steps using the + and - knob buttons on the console.

4. Carefully knob D:IB using the knob "+" (F4) and knob "-" (F5) keys on the console to align the traces on the FFT box as shown in Figure 16. Note that decreasing D:IB moves the Debuncher trace to the right. Make small changes. The changes made between the two displays in Figure 16 were only 0.045 A.

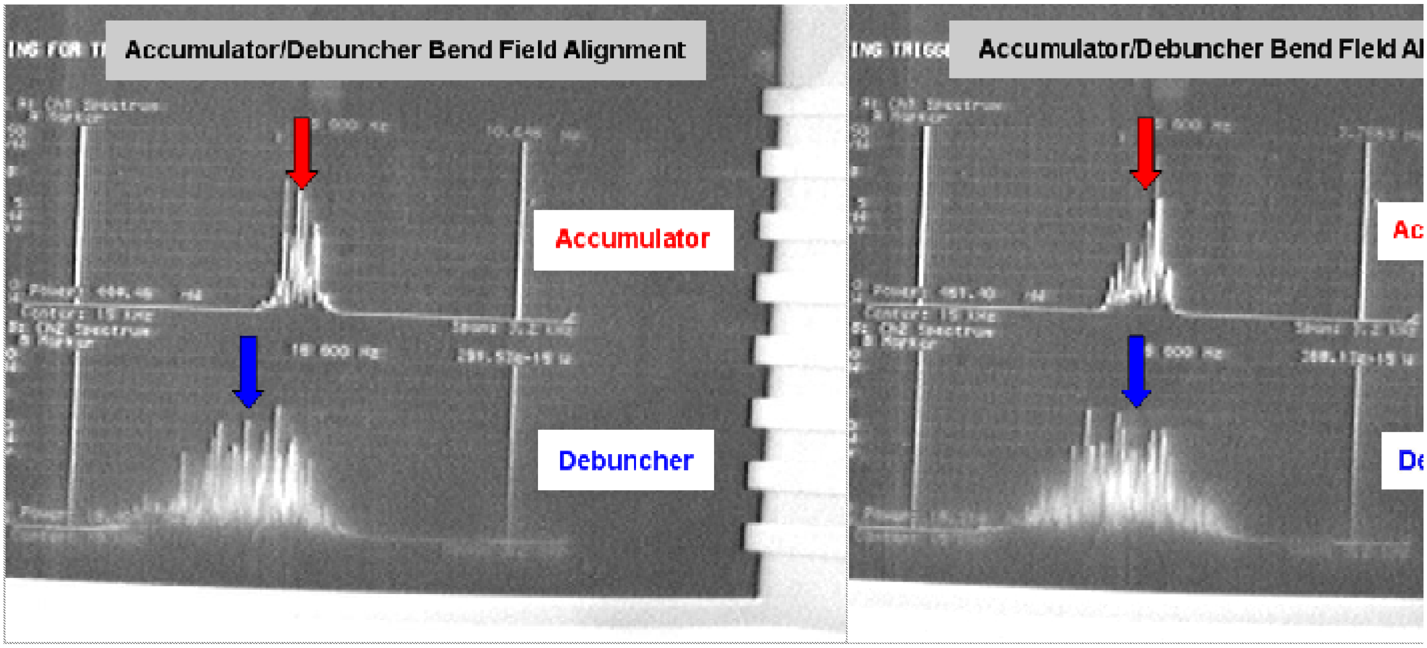

Figure 16: FFT VSA displays. The display on the left show a slight misalignment between the Debuncher and Accumulator bend fields. The display on the right shows the Debuncher and Accumulator bend fields aligned after at -0.045A change to D:IB.

5. Now that both the Debuncher and Accumulator bend fields are set, we are not quite done. We must now adjust the ARF1 injection frequency. Keep track of your changes and watch the FTPs that we started earlier.

Full Length Procedure: Part 4 - Fix ARF1 injection frequency

The final portion of this procedure is to adjust the ARF1 pickup frequency to compensate for the bend field changes that we have made.

1. The Stacktail Monitor VSA (SA1136) needs to be running with A:VSARST = 12 or 13. If the Stacking Monitor is already running, then skip ahead to step 5.
2. Open P142, click on "Start VSA," and select "Stack 4-8 GHz Momentum Thermostat." This will set A:VSARST = 13. Alternately, if there was reason to not run 4-8GHz momentum thermostat, then you would select "Stacking Monitor" instead. This would set A:VSARST = 12. We should normally run with A:VSARST = 13.

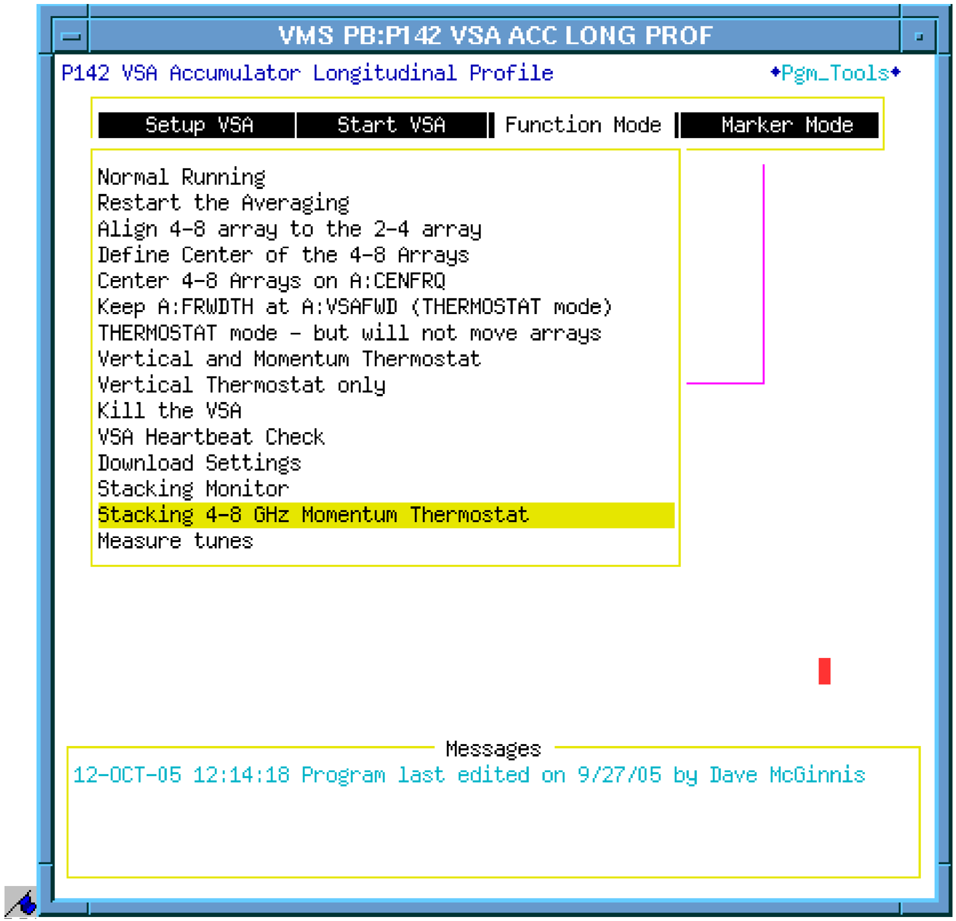

Figure 17: Selecting "Stacking 4-8 GHz Momentum Thermostat" from the "Function Mode" menu item on P142 is the same as setting A:VSARST = 13.

3. Start SA1136 by clicking on "Start VSA" in the menu-bar. If prompted, select to run the "new" SA.

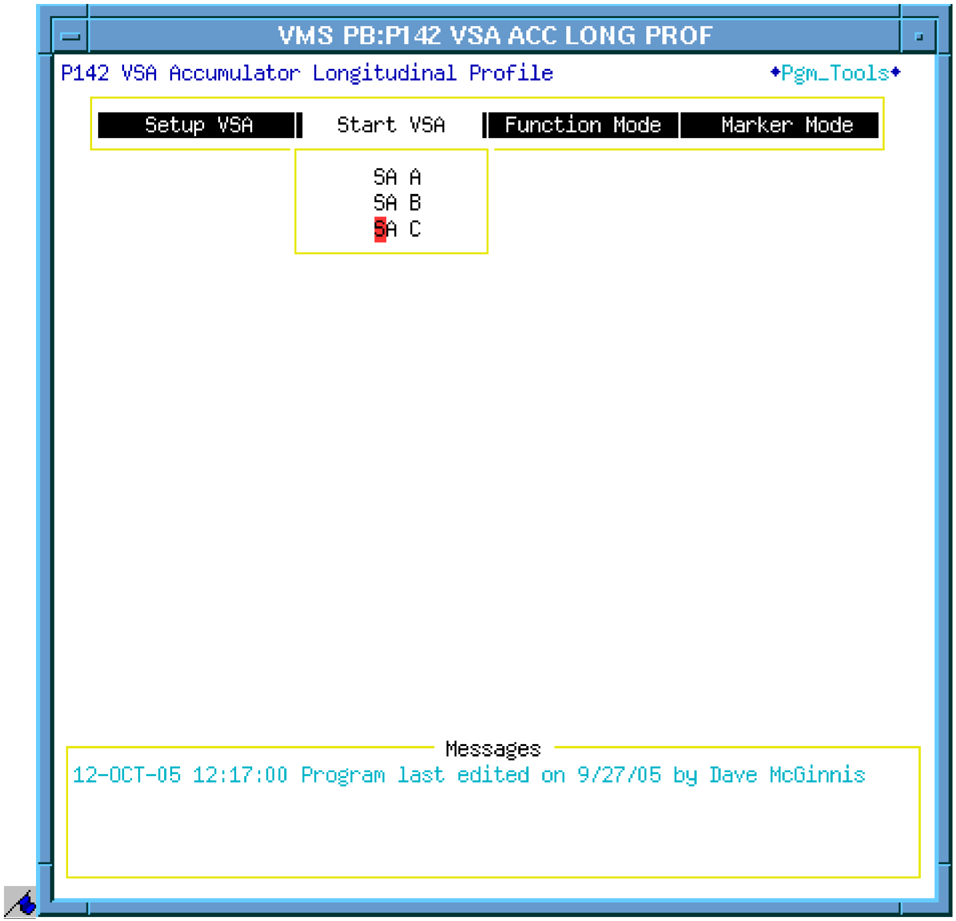

Figure 18: Once A:VSARST is set to 13, then start SA1136 by clicking on "Start VSA" and selecting an open screen.

4. When the Stacking Monitor SA1136 has been started, it should appear as shown in Figure 19, and should update with every stacking pulse.

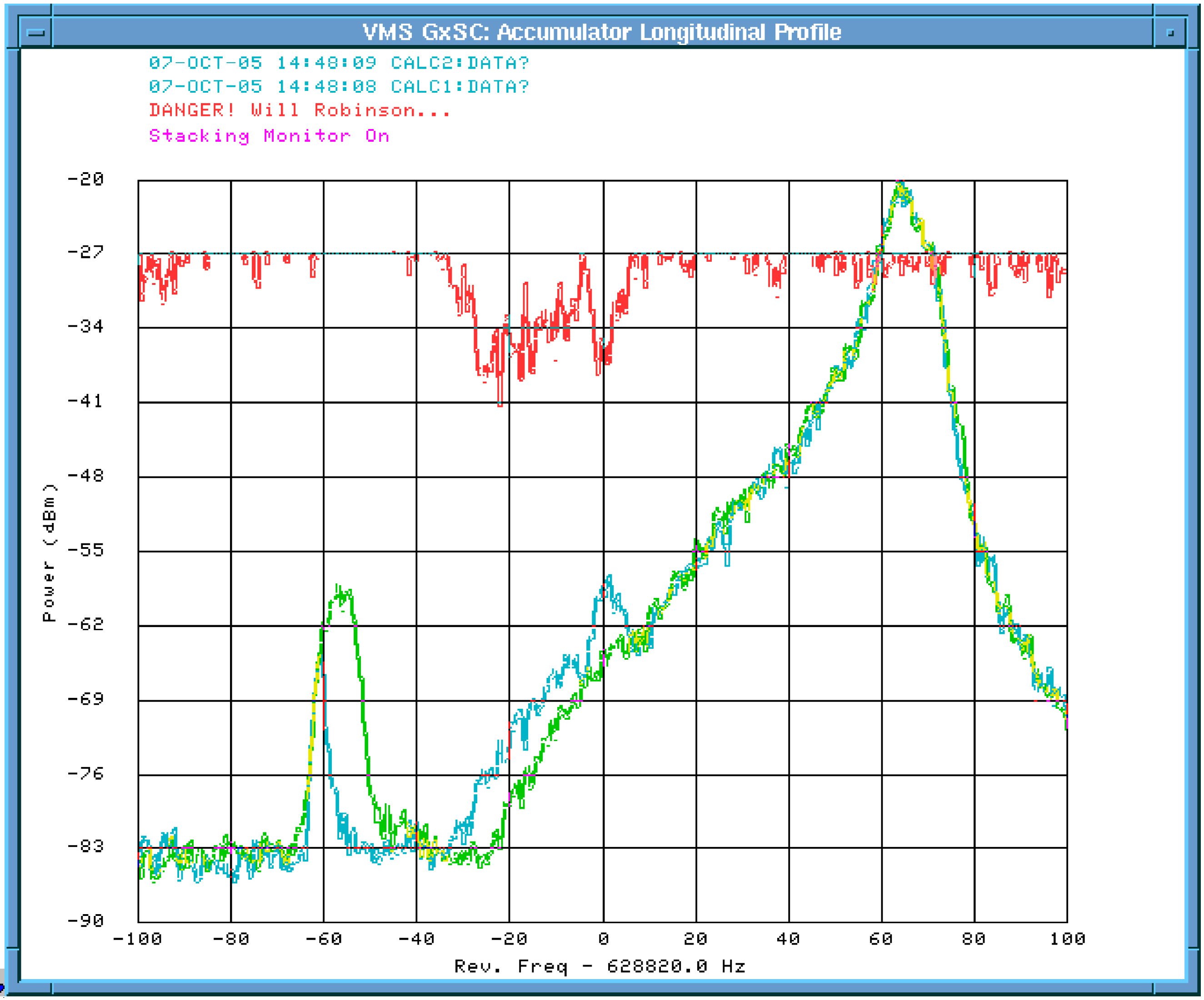

Figure 19: When the Stacking VSA is running, SA1136 should look like this screen capture. The green trace represents the Accumulator profile triggered before ARF1 ramps. The cyan trace represents the Accumulator profile after ARF1 has swept the injected beam to the deposition orbit. The red trace is the ratio of the green trace to the cyan trace in dB.

5. With the Stacktail Monitor running, we will now start two FTPs to help us determine if the ARF1 tuning changes we are about to make do us any good. Start a FTP from Utility Window FTP Pbar File 102 as shown in Figure 20.

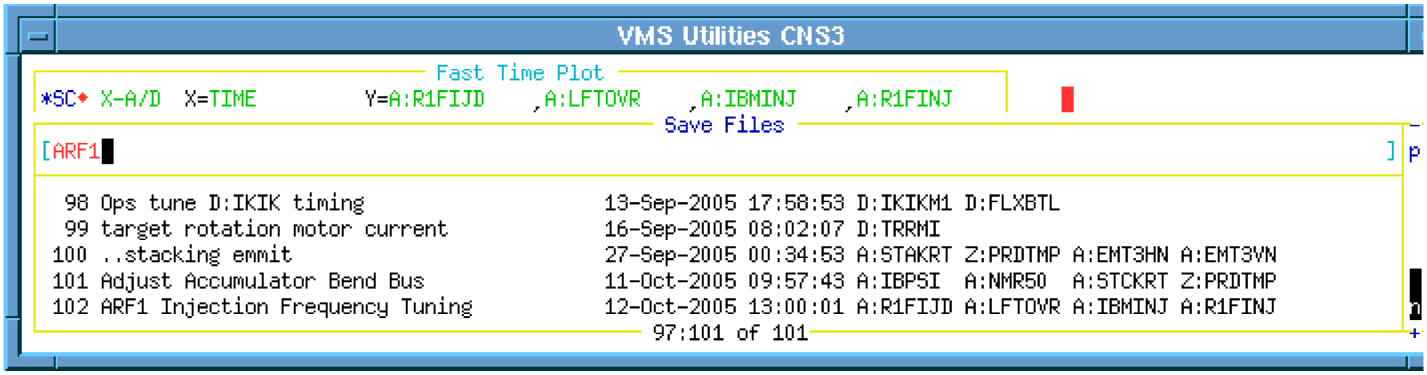

Figure 20: From the Utilities Window, click on FTP, then click on Restore, and then select P-bar. Select file 102 and start the FTP.

6. Utility Window FTP Pbar File 102 is shown in Figure 21. It monitors Accumulator devices generated by the Stacking Monitor as discussed in the background section. The devices plotted are the beam injected on the injection orbit before ARF1 ramps (A:IBMINJ), beam leftover on the injection orbit after ARF1 has ramped (A:LFTOVR), the current ARF1 pickup frequency (A:R1FINJ), and the suggested ARF1 pickup frequency correction (A:R1FIJD).

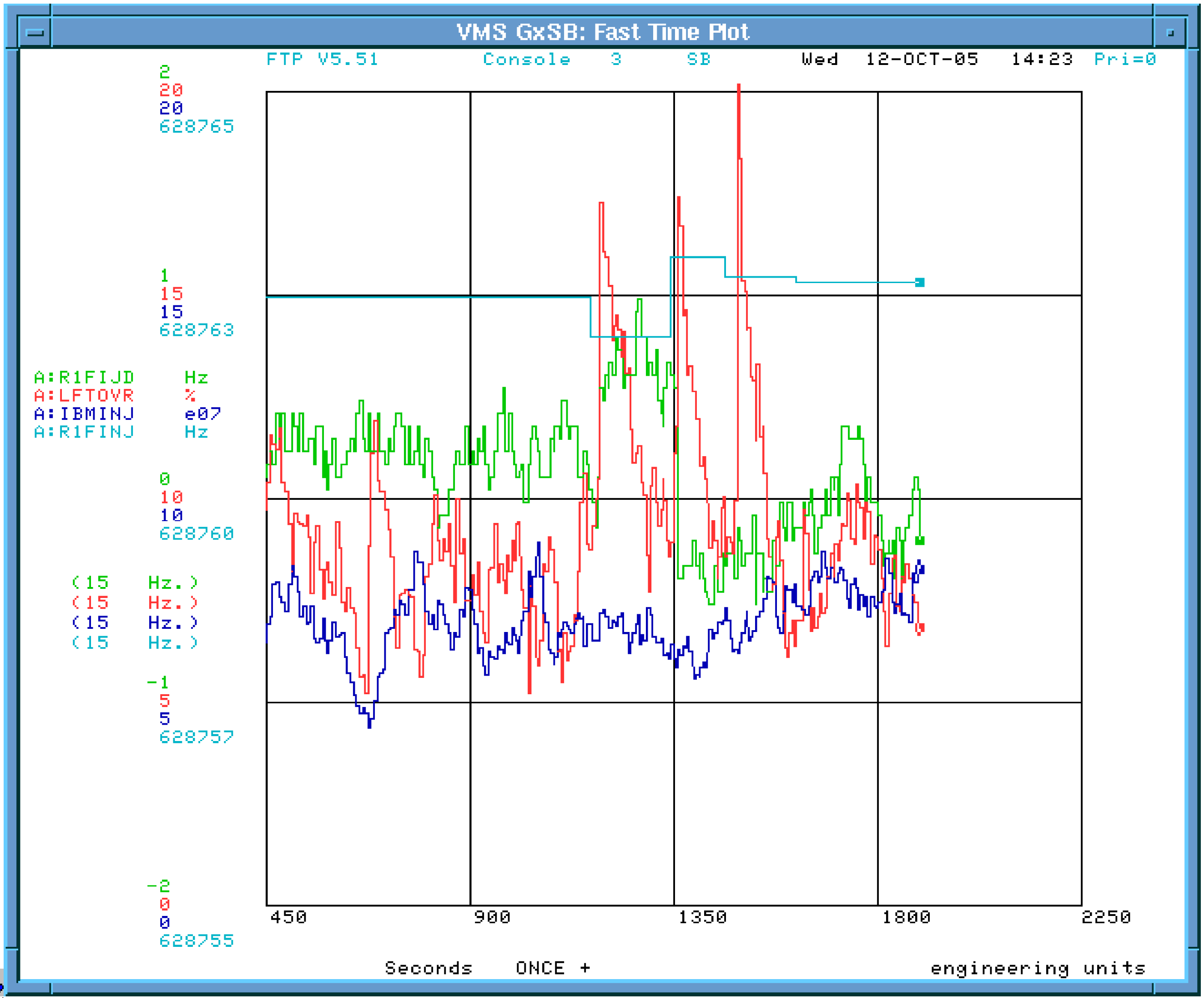

Figure 21: Pbar FTP #102 monitors Accumulator devices generated by the Stacking Monitor as discussed in the background section. The devices plotted are the beam injected on the injection orbit before ARF1 ramps (A:IBMINJ), beam leftover on the injection orbit after ARF1 has ramped (A:LFTOVR), the current ARF1 pickup frequency (A:R1FINJ), and the suggested ARF1 pickup frequency correction (A:R1FIJD).

7. We should also be sure that we are monitoring the stack rate and production, since our overall goal is to increase their values. If we are not monitoring these values, we can start Utility Window FTP Pbar File 100 as shown in Figure 22. Do not overwrite the plot that was started above in Figure 20.

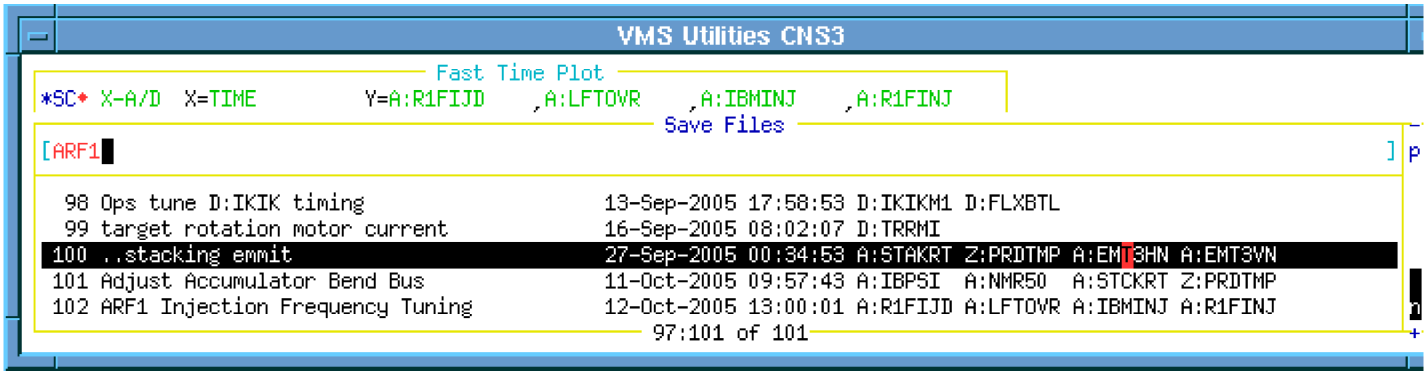

Figure 22: From the Utilities Window, click on FTP, then click on Restore, and then select P-bar. Select file 100 and start the FTP.

8. Utility Window FTP Pbar File 100 is shown in Figure 23. This plot shows the stack rate, production efficiency and the transverse emittances in the Accumulator.

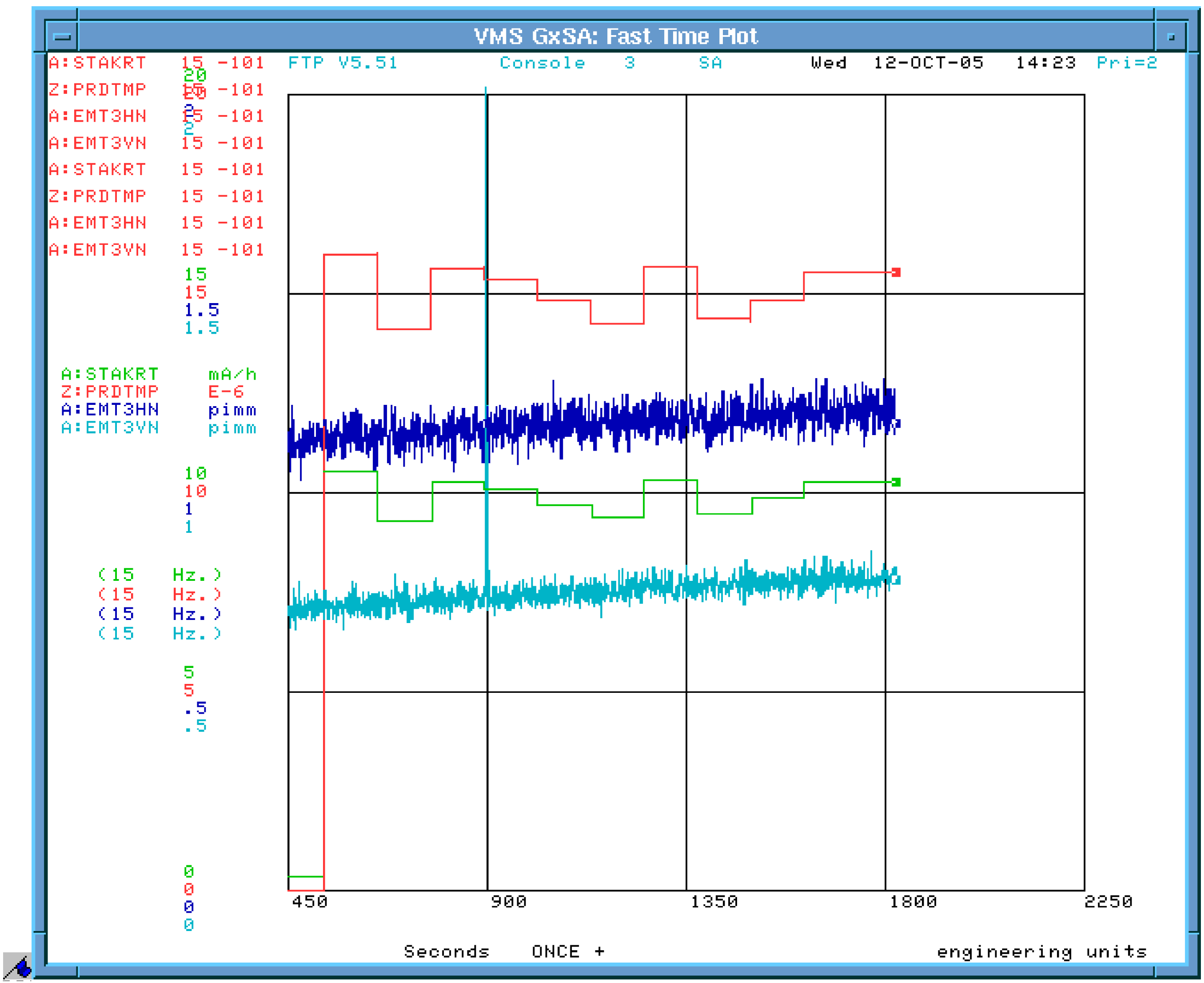

Figure 23: Utility Window FTP Pbar File 100 shows the stack rate, production efficiency and the transverse emittances in the Accumulator.

9. There are two helpful parameter pages shown in Figure 24. P8 ARF_1 <28> contains the ARF1 tuning parameters, and P38 McGinni <15> has the Stacking Monitor parameters.

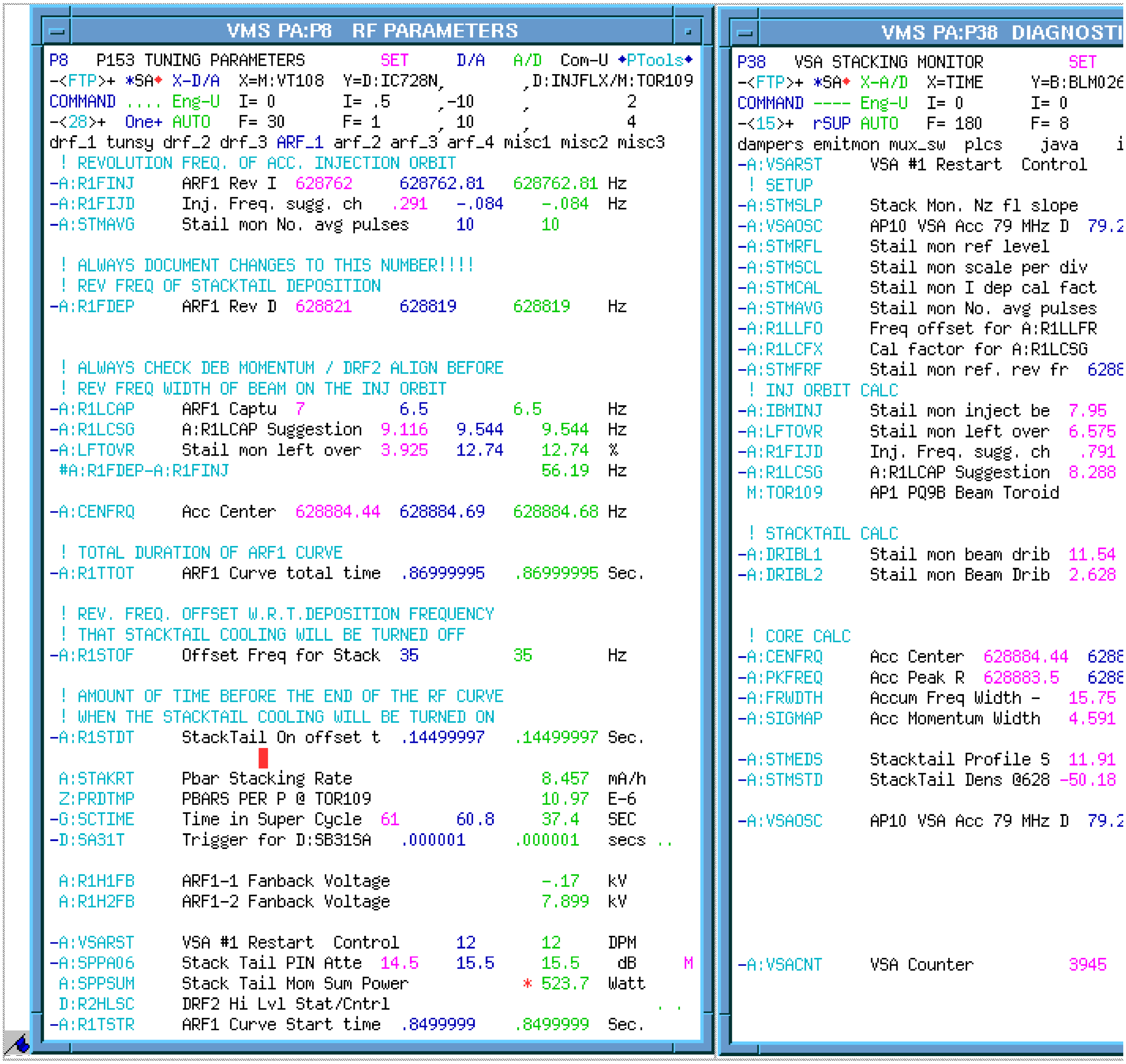

Figure 24:. The page on the left is P8 ARF_1 <28>, which contains the ARF1 tuning parameters. The page on the right is

P38 McGinni <15>, which has the Stacking Monitor parameters.

10. After watching the leftover beam parameter A:R1FIJD for a number of cycles on the FTP shown in Figure 21, add the average number of A:R1FIJD to the pickup frequency parameter A:R1FINJ. If A:R1FIJD is positive you will be increasing the pickup frequency, and if A:R1FIJD is negative you will be decreasing pickup frequency.
11. To send out the new pickup frequency value, go to P153 and click on "Calc n Load Crv" as shown in Figure 25.

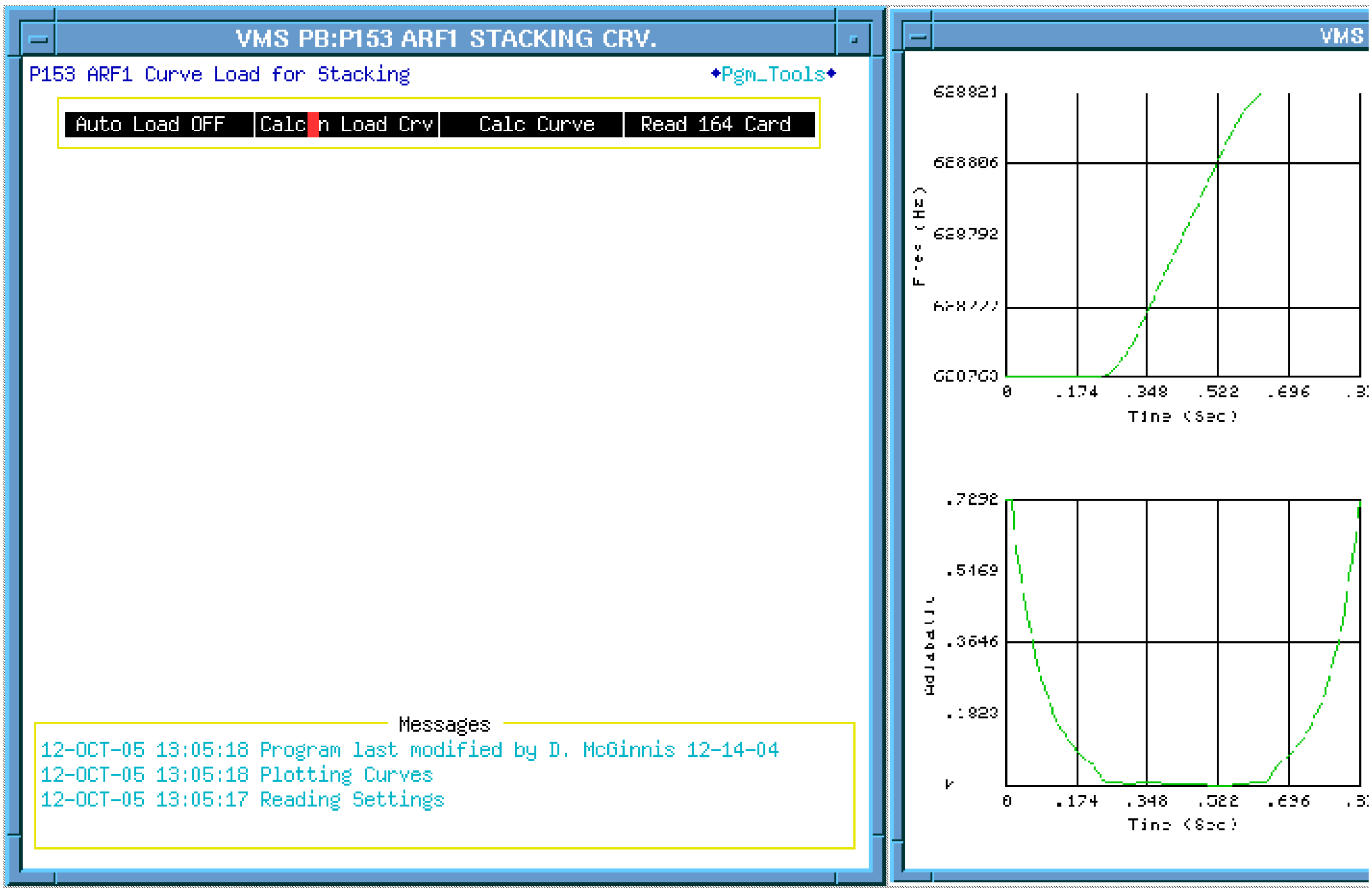

Figure 25: To send out your change to the pickup frequency, A:R1FINJ, open P153 and then click on "Calc n Load Crv."

12. Watch the FTP shown in Figure 21 for a number of beam pulses, as it will take a number of pulses for you to see how A:R1FIJD and A:LFTOVR have changed.
13. Repeat steps 10 and 12 as necessary to get A:R1FIJD = 0 Hz ±0.2 Hz.
14. A:LFTOVR should have stayed the same or decreased. If it increased or has a value greater than 10%, then we also will want tune the ARF1 bucket area. Tuning the ARF1 bucket area is beyond the scope of this document and will be

covered in a separate tuning guide document aimed specifically at ARF1 tuning.

15. Carefully look at all of the changes that were made. If stacking is worse, back out of your changes.
16. Document any tuning changes in the Pbar electronic log book.

Condensed Procedure:

The following is a condensed checklist of the steps covered in the above procedure. No screen captures nor motivating discussion are provided in this section. For more detail, discussion and screen captures, read the Full Length Procedure above.

1. Check Momentum Cooling alignment to insure that the cooling is set to 590018Hz.
2. Set the Accumulator Bend field.
   a. Start FTP from the Utility Window FTP restore file Pbar #101.
   b. Following the instructions on P60 ACC50 <40>.
3. Verify that the FFT VSA is updating every pulse from CATV AP channel 17. If the FFT display does not update on every pulse, setup the FFT box from P148
   a. Turn off the FFT OAC parameter by setting D:DAUSER to 0.
   b. Click on "Setup VSA" from the menu bar, and scroll down one page to select the file "PFD Testing."
   c. Click in the lower right corner to load the FFT box. Wait for load to complete.
   d. Turn back on the FFT OAC parameter by setting D:DAUSER to 1.
4. Set the Debuncher Bend field.
   a. Start two FTPs from Utility Window FTP restore files Pbar #88 and Pbar #89.
   b. Knob the Debuncher Bend field slowly using the knob "+" (F4) and knob "-" (F5) keys to align the traces on CATV Pbar Channel #17.
5. Optimize the ARF1 Injection Frequency
   a. Verify that the Stacking Monitor is running. If not, start it from P142.
   b. Start two FTPs from Utility Window FTP restore files Pbar #102 and Pbar #100.
   c. Set A:R1FINJ = A:R1FINJ + A:R1FIJD.
   d. Send the ARF1 changes from P153.
   e. Repeat until A:R1FIJD = 0 Hz ±0.2 Hz.
6. If stacktail power or production decreases, back out of your changes.
7. Document any tuning changes in the Pbar electronic log book.

For a more detailed treatment of this procedure, please see the Full Procedure.

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